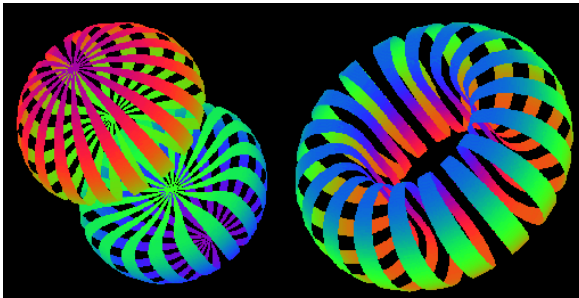


Direct Neutron Cross Section Measurements



**Nuclear Physics and Related
Computational Science R&D for
Advanced Fuel Cycles Workshop**

**J. A. Becker, et al.,
LLNL**

**G. E. Mitchell, et al.,
NC State**

**R. Nelson et al., D. Vieira et al.,
LANL**

Work performed, in part, under the auspices of the U.S. DoE by University of California, Lawrence Livermore National Laboratory under Contract W-7405-Eng-48.

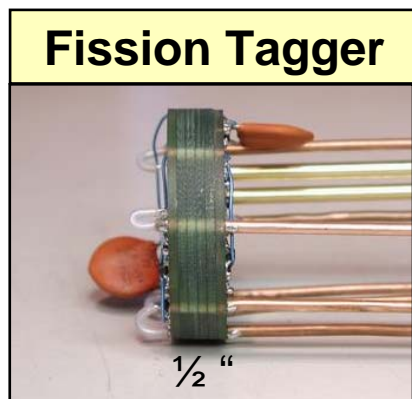
**Bethesda, Maryland
August 10-12, 2006**

Work performed, in part, under the auspices of the U.S. DoE by Los Alamos National Security, LLC, Los Alamos National Laboratory under Contract No. DE-AC52-06NA25396.

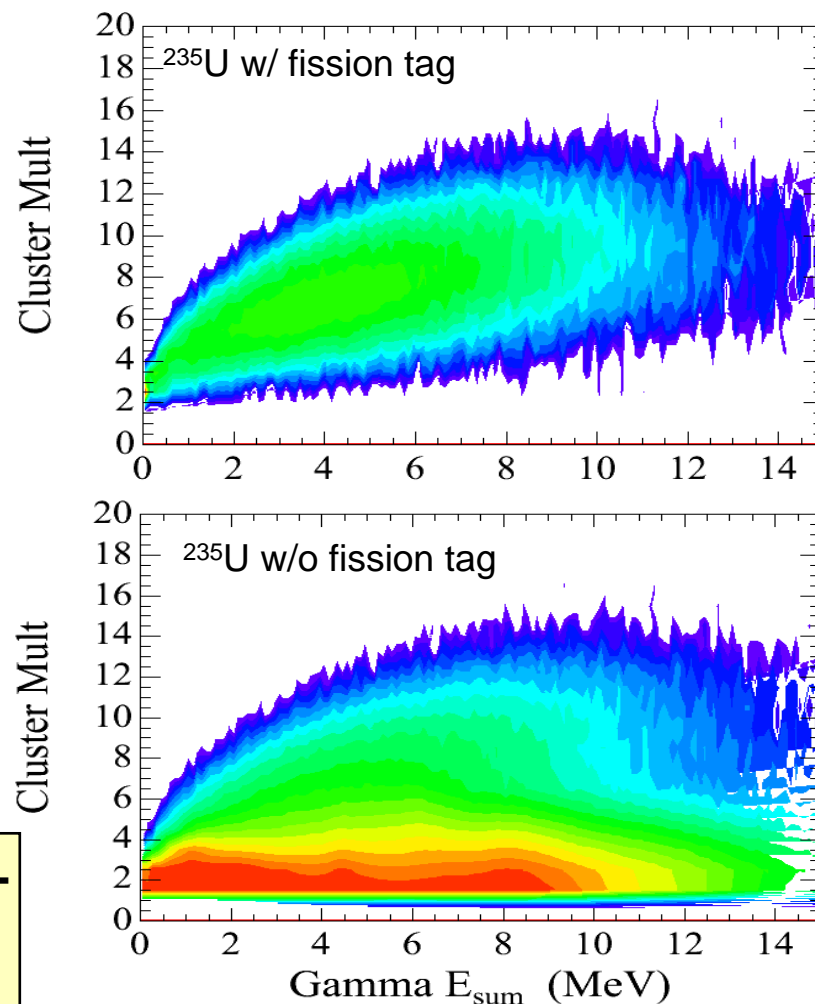
Direct (n,γ) and (n,f) cross sections with DANCE



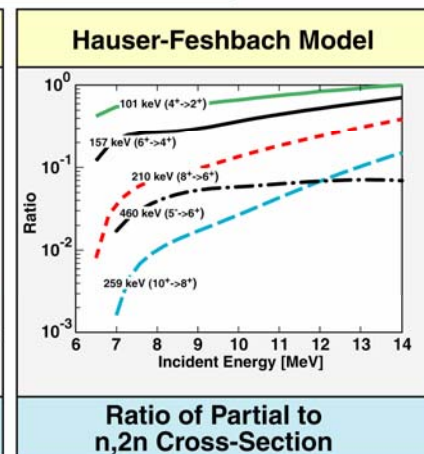
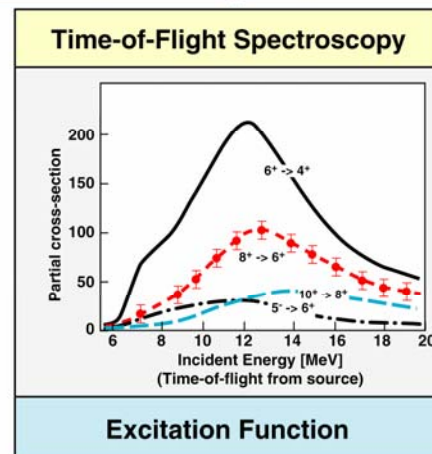
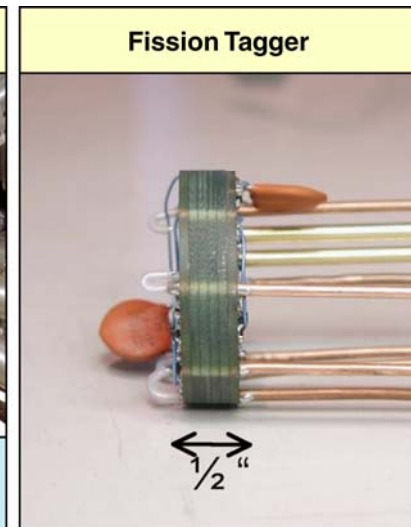
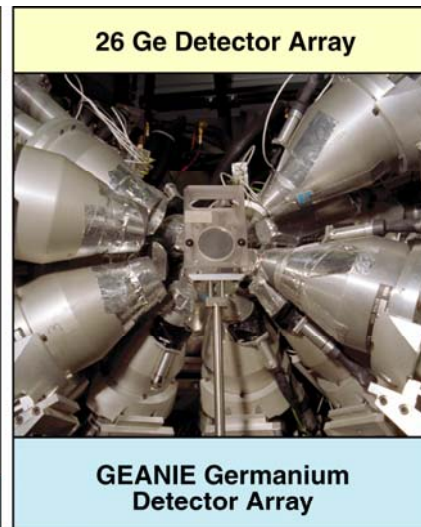
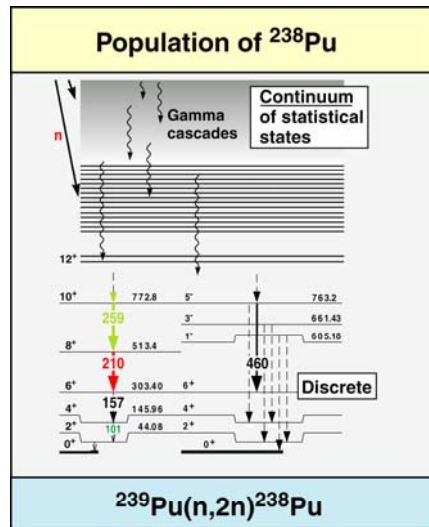
- (n,γ) and (n,f) processes compete for fissioning actinides
- Both emit γ -rays and are only partially resolved in DANCE data
- A 4π fission-tagging auxiliary detector resolves this problem



Improved (n,γ) data as well as capture-to-fission ($\alpha = \sigma_\gamma / \sigma_f$) measurements
— (E_γ) and (M_γ) for fission events



GEANIE – Unique tool to deduce neutron cross sections for $E_n > 100$ keV



- Inter-Lab collaboration
- Unique materials, facilities
- Pick out fission events with tag

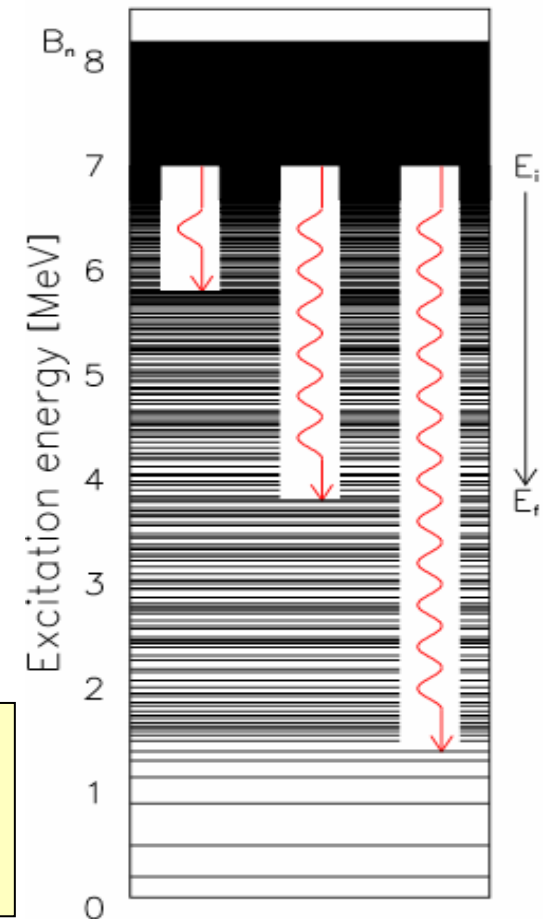
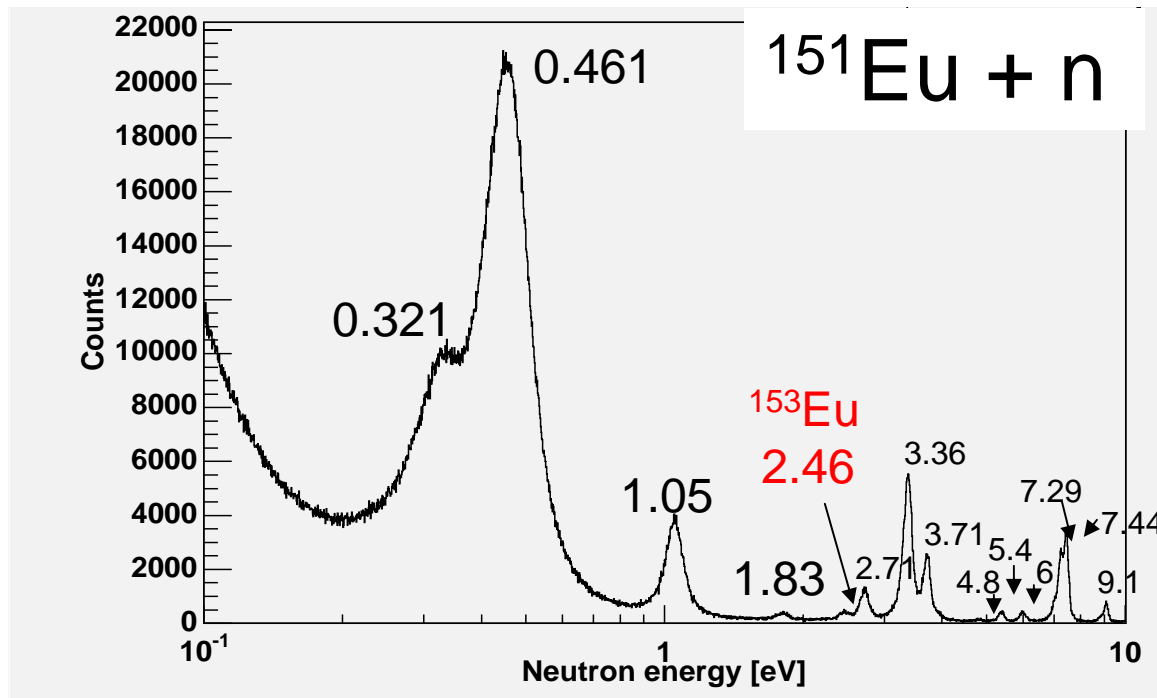
Direct cross section measurements as $f(E_n)$ with GEANIE (Enhanced) and DANCE



- Inelastic neutron cross sections (n,n') at fission neutron energies (GEANIE)
 - even-even actinides + fission products
 - Measure γ -ray production
 - infer n,n' cross section from measured partial γ -ray cross sections
 - Need modeling
 - Need partial level scheme
 - Active program now at GEANIE
- (n,f) including x-ray and γ -ray production at fission neutron energies
 - $^{239}\text{Pu} + ^{233}\text{U} + \dots$
 - extend to fission neutron energies at GEANIE/WNR
 - (n,γ) deduced from $6^+ \rightarrow 4^+$, $4^+ \rightarrow 2^+$ transition ???
- $(n,)$, (n,f) cross sections and their ratio, e.g., $^{242\text{m}}\text{Am}$
 - n,γ deduced from $6^+ \rightarrow 4^+$, $4^+ \rightarrow 2^+$ transition
 - Active program now at LANL/Lujan/DANCE with $E_n < 50$ keV
- (n,f) experiments at LSDS/LANSCE with $E_n < 100$ keV ^{237}U , $^{242\text{m}}\text{Am}$
 - Active program now at LSDS/LANSCE (Bob Haight, et al.)
- Significant enhancements to capabilities include:
 - GEANIE Fission Counter
 - GEANIE Frame to increase gamma-ray detection efficiency
 - GEANIE Fission Counter

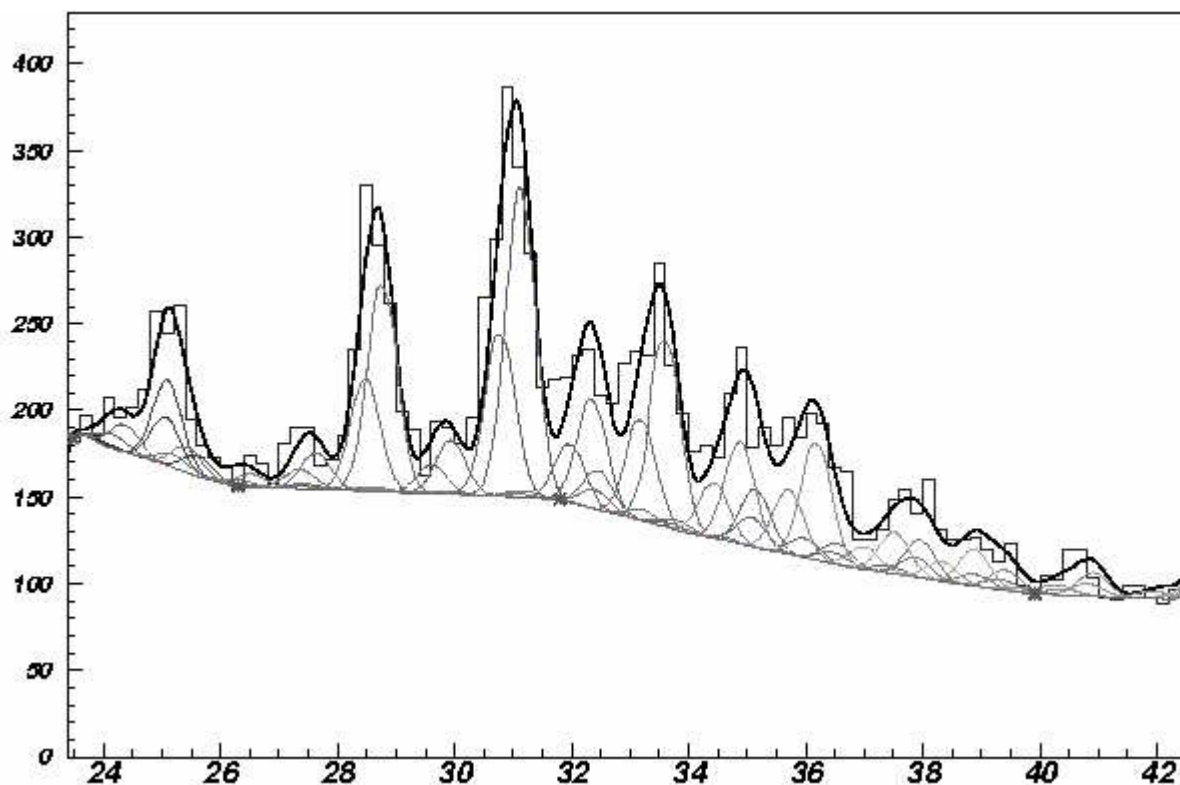
DANCE/LANCE — Nuclear Data

— Statistical Behavior of Nucleus



Cross Sections — resonance and keV region
Radiative decay of the excited nucleus
RadioActive samples — mg quantities

Spectrum of x-rays from $^{238}\text{U}(n,f)$ for $10 < E_n < 20$ MeV



GEANIE
LLNL/LANL



Target assembly

